PB-217 177

REPORT ON SPECIAL SANITARY PROBLEMS IN CONNECTION WITH THE SANITATION OF THE EXTRA-CANTONMENT ZONE AROUND FORT LEAVENWORTH, KANSAS

Harry B. Hommon

Public Health Service
Washington, D.C.

9 November 1917

DISTRIBUTED BY:

NTIS

National Technical Information Service
U. S. DEPARTMENT OF COMMERCE
5285 Port Royal Road, Springfield Va. 22151

LIBRARY
SANITARY ENGINEERING CENTER
CINCINNATI, OHIO

PB 217 177

560.208

REPORT ON SPECIAL SANITARY PROBLEMS IN CONNECTION WITH THE SANITATION OF THE EXTRA-CANTONMENT ZONE AROUND FORT LEAVENWORTH, KANSAS,

Details of illustrations in this document may be better studied on microfiche.

By HARRY B. HOMMON,
SANITARY ENGINEER,
U.S.PUBLIC HEALTH SERVICE.

November 9, 1917.

Reproduced by
NATIONAL TECHNICAL
INFORMATION SERVICE
U S Department of Commerce
Springfield VA 22151

77

This report is made up of the following special studies:-

1. Report on the City Water Supply;

2. City ordinances covering -- the construction and operation of privy vaults and connections with city sewers, the maintenance and disposal of manure, and the collection and disposal of garbage;

3. Recommendations for remodeling the sewage disposal plant at the Leavenworth County Hospital.

4. A report to the Consumers' Ice Company of Leavenworth, regarding the handling of the water used for making ice, and an article to be published in "Ice and Refrigeration" on the subject of filtering and storing water in distilled water ice plants.

SPECIAL REPORT ON THE WATER SUPPLY of Leavenworth, Kansas.

by

H. B. Hommon
Sanitary Engineer U. S. Public Health Service.

INTRODUCTION

On August 14, Asst. Surgeon J. G. Wilson, U. S. Public Health Service was detailed to take charge of health activities in the Extra Cantonment Zone around Fort Leavenworth. Upon his arrival at Leavenworth he found a very serious typhoid fever epidemic in the city with some indications pointing to the city water supply as the source of the epidemic. Dr. John J. Sippy, Epidemiologist of the Kansas State Board of Health and Mr. Harold Streeter, Sanitary Engineer of the U. S. Public Health Service, had made reports on the relation of the water supply to the typhoid fever epidemic and each recommended that a detailed study be made to learn more about the sanitary quality of the city water supply. Following out these suggestions Dr. Wilson requested that a sanitary engineer from the U. S. Public Health Service be detailed for this investigation and the writer was ordered to Leavenworth on September 1st.

The first cases of typhoid fever were reported in February and new cases developed daily till August when the epidemic reached its height. In order not to lose any time in starting a laboratory the Surgeon General, U. S. Public Health Service, in Washington ordered the Interstate Laboratory Car "Wyman", in charge of Asst Surgeon, C. V. Aiken, to Leavenworth.

This car arrived on August 20th and samples of water from various taps on the city water mains were examined. Although these analyses indicated the water was satisfactory at that time, it was nevertheless decided that the examination recommended by Dr. Sippy and Mr. Streeter was necessary before definite conclusions could be reached, and this report may be considered as a continuation of the two referred to above.

The city of Leavenworth is situated along the west bank of the Missouri River and has a population of approximately 20,000. Adjacent to the city on the north is the Government Reservation on which are located Fort Leavenworth, the Disciplinary Barracks, and the Federal Prison. The National Soldiers' home lies to the south just beyond the city limits. The number of officers and enlisted men at the Fort varies, but it is anticipated that there will soon be approximately 10,000 men there, and in addition there are about 1500 at the Disciplinary Barracks. At the Federal Prison there are 1600 men and at the soldiers home approximately 2000 inmates during the summer and 2600 during the winter. The total population in and adjacent to Leavenworth is at the present time, or soon will be, approximately 35,000.

DESCRIPTION OF TREATMENT PLANT

The water XXXXXX for all this population is supplied by the Leavenworth City and Fort Leavenworth Water Company. The pumping station and treatment plant are located on the west bank of the river about one mile above the city and above all the sewer outlets from the city but only a mile below the outlet from a septic tank receiving the sewage from 1600 men at the Disciplinary Barracks at the Fort. All the other sewage from the Government

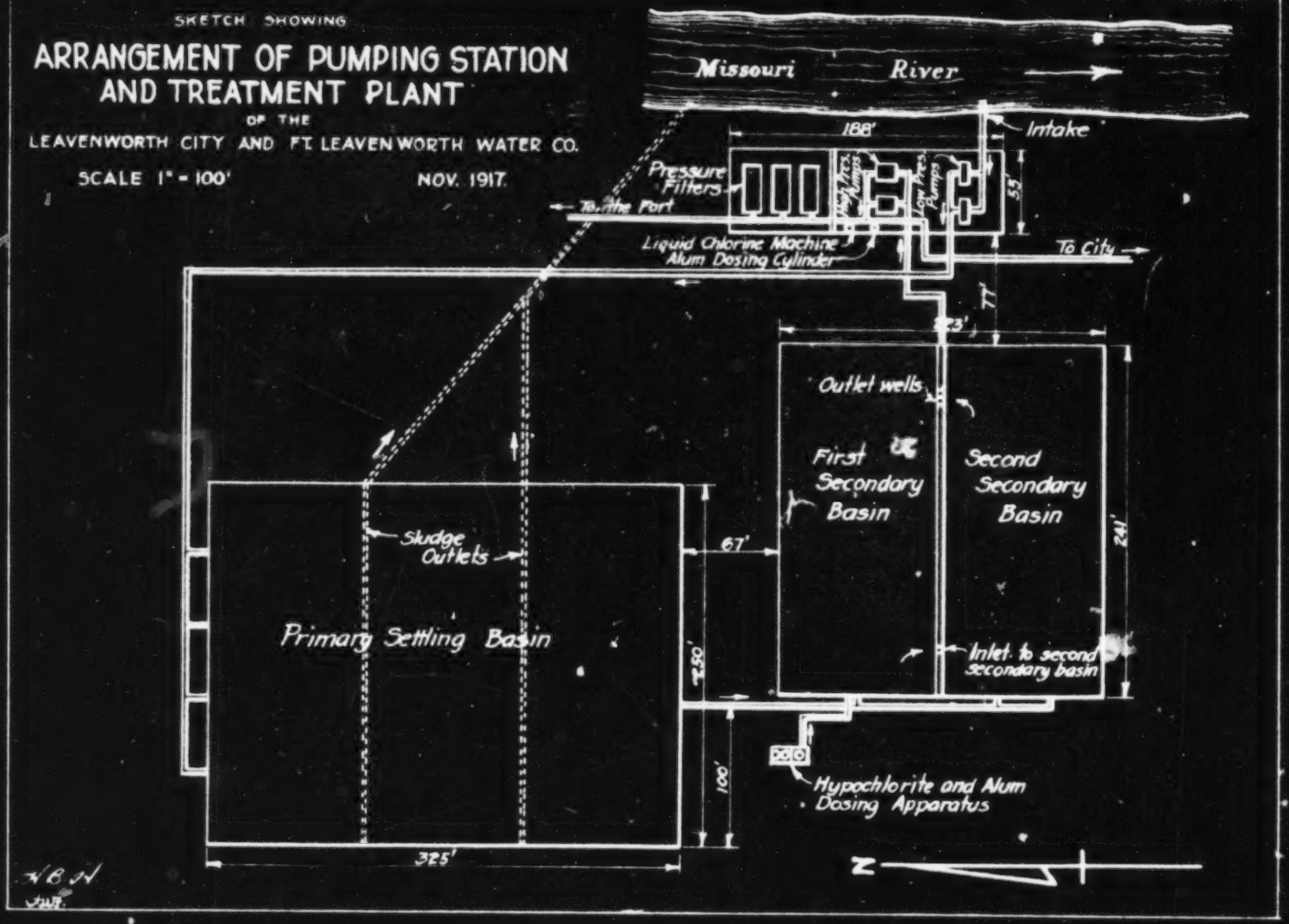
SKETCH SHOWING

ARRANGEMENT OF PUMPING STATION AND TREATMENT PLANT

OF THE

LEAVENWORTH CITY AND FT. LEAVENWORTH WATER CO.

SCALE 1" = 100' NOV. 1917.



Reservation is carried by a trunk sewer below the pumping station and discharged into the river. The intake to the pumps is about 25 feet from the bank at low water stages. The water is raised by low lift pumps to a primary settling basin that has an area of 325 feet x 250 feet and is 20 feet deep at the outlet end. The sides of the basin slope to an angle of 45 degrees and the bottom towards two sludge outlets which pass through the east wall of the basin. The capacity of the basin when free of mud is 8,250,000 gallons.

On the way to the primary basin the water is treated with aluminum sulphate during a part of the year at a rate varying from 3 to 6 grains per gallon. The storage period of this basin after cleaning is a little more than two days. The outlet is at the opposite end from the inlet pipes and consists of a well with four openings into the reservoir, one 4 feet from the bottom, one 8 feet, one 12 feet, and the fourth 16 feet. The one used depends upon the height of the mud over the bottom of the basin.

From the well at the outlet of the primary basin the water flows by gravity to the first secondary basin, 241 ft. x 132 ft. x 15 ft. deep, which has a capacity of 3,000,000 gallons and a storage period of a little less than one day. The inlet to this basin consists of a 12 inch pipe located about 2 feet below the normal water level. As the water enters it receives aluminum sulphate at the rate of 3 to 5 grains per gallon depending on the turbidity of the water, 3 grains being the usual rate during the summer time and the amount applied while the present investigation was conducted. The water from the first secondary basin

flows to a second secondary basin through a port in the south wall located about 10 feet east of the west wall through which the water from the primary basin enters the first secondary basin. In other words the outlet is at the same end as the inlet but not through the same wall, the inlet being in the end wall and outlet through the partition wall that separates the two bains. The second secondary basin is the same size as the first secondary but the water travels through the longest dimensions to a well from which it flows by gravity to the high pressure pumps. Just before reaching the pumps the water is treated with liquid chlorine at the rate of approximately .44 parts per million.

The total storage in the reservoirs at the pumping station when all the basins are free of mud is approximately 4 days. The primary basin with a capacity of approximately 8 1/4 million gallons provides storage for a little more than 2 days and the primary basins with a combined capacity of about 6 million gallons a little less than 2 days. The amount of water pumped to the mains for all purposes was measured at 11 a. m. on October 18th by noting the fall of the water level in the secondary basins for 3 hours, and the amount computed for 24 hours was found to be 3,780,000 gallons.

The water supplied to the city of Leavenworth, the Federal Prison and the Soldiers Home is that coming from the final settling basin while that delivered to the Fort is passed through pressure filters. The water pumped to the city in excess of the consumption is stored in a circular reservoir 216 ft. in diameter and 22 feet deep located on a hill on the opposite side of the city from the pumping station and known as Pilot Knob.

[redacted] The depth of water in the reservoir is 20 feet. The elevation of this reservoir is approximately 300 feet above the pumping station and the capacity 5,460,000 gallons.

The water flowing in the Missouri River is turbid at all times, the minimun turbidity during low water stages in the coldest weather averaging about 80 parts per million and running as high as a thousand or more during flood stages. It is likewise badly contaminated at all times by the sewage from the cities of Atchison, Kansas, St. Joseph, Mo., and other cities further up the river and the small towns on the main river and its tributaries. The river usually has two rises, one is March and another in the early summer, but local rains may change the character of the water many times during the period outside the more or less regular flood stages.

The engineer at the pumping station varies the amount of alum added to the water according to his judgment and experience in treating the water but without any laboratory control or any data by which he can determine the turbidity and apply his coagulant accordingly. The apparatus for applying the aluminum sulphate to the water on the way to the primary settling basin is very crude. It consists of an iron cylinder 18 inches in diameter and 3 feet deep with a top bolted onto the cylinder. In operation about 70 pounds of alum is added to this cylinder every hour, the top bolted on tight and tap water passed through the alum in the cylinder and into the discharge line from the low lift pump as the river water passes to the primary settling basin. From this procedure it can be easily seen that the first water passing through the cylinder contains a large amount of alum while the

7

Primary Settling Basin, showing the Outlet Well.

Removing mud from Primary Settling Basin at the outlet end of the Basin. Outlet Well is shown extending up through the Sides of the Basin.

portion leaving it at the end of the hour probably does not contain any alum at all. The amount of alum added at this point varies from none to 6 grains per gallon, the average amount for ordinary river stages being 3 grains.

Between the primary settling basin and the first secondary basin alum is again added by a device equally as crude as the one described above. It consists of an iron cylinder holding about 20 gallons with a top that can be bolted down tight but this is not ordinarily done as the water from the cylinder flows by gravity into the basin. In normal operation and when treating water with low turbidity about 70 lbs. of alum is added to this cylinder every hour and water from the high pressure mains passes through the alum and into the basin. The same criticism applies to this method of applying the alum as was given in the discussion of the apparatus for adding the alum to the water just previous to entering the primary settling basin. A strong solution goes to the water at the beginning of the hour and a very weak solution or perhaps no alum at all at the end of the hour. Observations made at the plant proved that at the end of the hour practically no alum was going into the water.

The alum added to the water on its way to the primary basin is probably thoroughly mixed while it passes from the point of application to the reservoir some 300 yards away, but the alum added to the inlet of the first secondary basin does not have time to become thoroughly mixed with the water entering before it is dispersed in the reservoir.

The first basin receiving the raw water is efficient for

Secondary Settling Basins, and Alum and Emergency Hypochlorite House in the background.

Removing mud from First Secondary Basin. Cribbing at far end of Basin on the right is filled with 8-inch Limestone and is used as a Filter when this Basin is the Final Settling Basin.

settling purposes althe properly arranged baffles would no doubt increase the amount of mud removed. In the first secondary basin it is very evident that a large percentage of the water does not remain more than a fraction of the time it should. As stated before the inlet is in the west wall near the north side and the outlet in the east partition wall about 10 feet from the west wall. The water enters under a head of about 20 feet and the velocity is sufficient to force it some distance toward the opposite end of the basin but it is not reasonable to expect that the full settling capacity can be obtained with the inlet and outlet at the same end of the basin. A series of baffles at the inlet end of this tank to insure thorough mixing of the alum with the incoming water and a longitudinal baffle to force the water to travel the full length of the basin and return would no doubt increase the efficiency of this basin.

In the second secondary basin the water in passing from the inlet near the west wall to the well near the east wall receives as near the maximum detention period as can be obtained without the installation of baffles.

The apparatus for applying the liquid chlorine to the water coming from the final settling basin is of an approved type and when it is in working order chlorine is applied continuously and at a uniform rate, but when it is out of operation for repairs the only other method available for sterilizing the water is to add calcium hypochlorite. The apparatus used for applying the hypochlorite solution consists of two wooden tanks each 5 feet in diameter and 4 1/2 feet deep. The stirring device consists of

paddles attached to the bottom of a shaft which is operated by water power. This part of the device is satisfactory but the tanks have been practically destroyed by the action of the chlorine. In fact on one occasion when the chlorine gas machine was closed down for repairs and it was necessary to use the emergency hypochlorite apparatus, it was found that both tanks were in very poor condition. One leaked so much that it could not be used and the other leaked out more solution than was applied to the water. In the only tank that could be used the iron bands that held the staves together were almost rusted through and the staves were so soft that the solution came through at many points. An emergency apparatus made of material not attacked by chlorine is obviously needed to supplement the one liquid chlorine machine.

The mud and alum precipitate is removed from the primary settling basin ordinarily twice per year, once after the March floods and again after the spring rise. This year on account of a third flood stage in July this basin has only been cleaned once since the March floods. Some of the deposit was washed down from the sides of the reservoir and removed in Sept/ember, but there was in this basin on October 24th about 10 feet of solid mud a part of which has been there since last April. It was stated by the superintendent of the Water Company that approximately 15 feet accumulates during the year. The deposit in the first and second secondary basins is removed twice each year, once in the spring and again/in the late fall.

All three of the basins have been drawn down since this investigation started, the mud from the sides and outlets- 12

removed from the primary and first secondary basins only while the deposit from the final basin was practically all removed. There was a large deposit of grayish, light, floculent sludge around the stone cribbing at the outlet of the final settling basin that resembled the alum floc.

The sludge washed from all basins is discharged into the river, that from the first where the largest amount accumulates going into the river about 100 feet above and in direct line with the intake to the pumps. The sludge from the other basins is discharged into the river below the intake.

The plant described above is used for treating the water delivered to the City of Leavenworth, the Federal Prison and the Soldiers Home. That furnished the Fort, receives the same treatment as that for the city and in addition is filtered through pressure filters. These filters are operated in the usual way except that after each washing, alum is added to the first water applied to the surface in order to form a floc and a mat. All three of the filters are washed on Tuesdays, Thursdays and Saturdays, the wash water going into the river only a short distance above the intake of the low lift pumps.

SPECIAL REPORTS MADE PREVIOUS TO SEPTEMBER 1st.

Before presenting the results and proceeding with the discussion of those obtained since September 1st., at which time the writer began his investigations, the analyses obtained before that time will be given. The State Board of Health analyzed samples sent in weekly by the Water Company

and they are given below together with the river stages.

Report by the State Board of Health showing River Stages and Bacterial Analyses of Samples of Water from the Leavenworth City and Fort Leavenworth Water Company.

Date	River Height	Lab. Analyses 1cc. Tube	(Bile Lactose) 10cc. Tube
1 - 2	37.7	5-	-
1 - 9	38.0	5-	-
1 - 15	38.8	5-	-
1 - 22	38.7	5-	-
1 - 27	39.0	5-	-
2 - 5	39.9	5-	-
2 - 12	39.8	1+& 4-	-
2 - 19	39.6	5-	+
2 - 26	39.1	5-	
3 - 5	39.2	5- (Turbid)	-
3 - 12	41.0	5-	-
3 - 19	40.6	5- Heavy & Muddy	-
3 - 26	43.4	5- Turbid	-
4 - 2	42.2	5-	-
4 - 9	43.5	5-	-
4 - 16	48.0	5-	-
4 - 23	48.0	5-	+
4 - 30	46.2	5-	-
5 - 7	44.7	5-	+
5 - 14	43.8	5-	-
5 - 21	42.2	5-	-
5 - 28	47.0	5-	-
6 - 1	48.1	5-	-
6 - 11	52.0	5-	+
6 - 18	48.8	5-	-
6 - 25	48.4	5-	+
7 - 2	50.1	5-	+
7 - 9	49.7	5-	-
7 - 17	47.2	5-	-
7 - 19	47.2	3+2-	+
7 - 23	46.0	5-	-
7 - 30	43.8	3+ 2- (Turbid)	+
8 - 4	43.2	2+ 3- (Turbid)	+
8 - 13		5-	-
8 - 21		5-	-
9 - 21		5-	-
9 - 3		5-	-
9 - 18		2+ 3-	+
9 - 11		5-	-

Date	River Height	Lab. Analyses 1cc. Tube	(Bile Lactose) 10cc. Tube
10 - 3		5-	-
10 - 8		5-	-
10 -13		5-	-
10 -16		5-	-
10 -22		5-	-

Note - Five 1 cc. and one 10 cc. samples were tested for B.coli

The analyses given in the preceding tables show that samples collected on July 19th, and 30th, and August 4th and Sept 18th, contained B.coli in at least one out of five of the 1 cc. samples tested on those days and there were B. coli in the 10 cc. samples sent in on ten different days. Six samples were marked as turbid. How long after the water from which the samples were taken showing the presence of B. coli or turbidity, remained turbid and contained B. coli is not definitely known, but it is safe to assume that the water in the mains remained in the same condition as found in the samples for at least several hours afterwards and probably was in that condition for several hours before. Daily analyses would have given a history of the water at the times when the water was turbid and contained B. coli in occasional samples that would have either fixed the blame on the city water supply for the presence of typhoid fever in Leavenworth or else removed any doubt as to whether the water carried the bacteria that started the epidemic. The Water Company engaged the Kansas City Testing Laboratory to make weekly analyses of samples of water collected by a representative of the Laboratory and these results are given in the following table:-

all heading

REPORT BY THE KANSAS CITY TESTING LABORATORY,

showing the Chemical and Bacteriological Analyses of Samples from the Mains of the Water Company, collected once per Week.

Date	Source	Temperature	Alkalinity	Chlorine	Temporary Hardness	Bacteria, Total Count	Bacteria, Coli in 1 c.c.
1-4-17	Tap down Town	39° F.	265	34	265	110	0
1-12-17	"	39	245	30	245	24	0
1-19-17	"	36	248	31	248	15	0
1-26-17	"	38	225	26	225	20	0
2-2-17	"	36	224	24	224	10	0
2-7-17	"	38	235	24	235	20	0
2-15-17	"	38	225	26	225	14	0
2-22-17	"	39	196	25	196	40	0
3-2-17	"	39	165	19	165	40	0
3-7-17	"	42	156	29	156	12	0
3-14-17	"	41	141	24	141	18	0
3-22-17	"	47	116	21	116	30	0
3-30-17	"	49	97	20	97	15	0
4-8-17	"	48	110	16	110	45	0
4-12-17	"	52	91	12	91		0
4-27-17	"	57	108	12	108	7	0
5-8-17	"	51	96	11	96	14	0
5-11-17	"	52	102	15	102	50	0
5-18-17	"	66	127	14	127	9	0

Date	Source	Temperature	Alkalinity	Chlorine	Temporary Hardness	Bacteria, Total Count	Bacteria, B Coli in 1 cc.
6-1-17	Tap down town	64	110	13	110	12	0
6-8-17	"	68	96	11	96	25	0
6-19-17	"	71	101	9	101	25	5
6-20-17	"	71	105	11	105	30	0
6-29-17	"	77	126	1 1	126	100	0
7-6-17	"	78	109	11	109	15	0
7-13-17	"	78	93	9	93	35	0
7-19-17	"	79	112	9	112	38	0
7-21-17	"	80	108	9	108	10	10
7-28-17	"		101	10	101	15	0
8-4-17	"	83	75	8	75	5	0
8-8-17	"	80	86	11	86	30	0
8-9-17	"	79	86	11	86	25	0
8-10-17	"	78	87	11	87	30	0
8-11-17	"	78	90	10	90	2242	0
8-13-17	"	78	75	11	75	2223	0
8-14-17	"	78	73	11	73	2418	0
8-15-17	"	78	76	11	76	40	0
8-16-17	"	78	83	11	83	12	0
8-17-17	"	79	77	12	77	20	0
8-20-17	"	79	82	12	82	13	0
8-25-17	"	76	72	11	72	7	0

Samples taken at Fifth and Delaware Streets.

The chemical analyses have no particular significance from a sanitary standpoint in connection with this water and discussion of these results is omitted.

The total number of bacteria per c.c. in all the samples except one is well within the standard set by the U. S. Public Health Service for water delivered to interstate carriers, but the B. coli tests were only made in 1 c.c. samples and the absence of B. coli in all the samples can not be accepted as showing the sanitary quality of the water. The standard established by the U. S. Public Health Service for interstate carriers and sanctioned by the American Public Health Association requires that the total number of bacteria shall be less than 100 per c.c. and that five samples of 10 c.c. each, one sample 1 c.c. and one sample 0.1 cc shall be tested for B. coli and that a water to be safe for drinking purposes shall contain at least four out of the five 10 c.c. samples that are negative when confirmed on lactose broth.

In addition to the weekly analyses made for the Water Co., by the Kansas City Testing Laboratory, the Water Co. had a special series of daily tests made by Mr. Waldin Williams, Chemist and Bacteriologist for ~~the~~ Kansas City, Kansas, covering the period from August 9th to 28th inclusive. The results of his analyses are given in the following table.

REPORT OF MR. WALDIN WILLIAMS TO THE WATER COMPANY showing Turbidity and Bacterial Analyses of Water from City Mains during August.

Date-1917						Bacteria			
						Total Per c.c.	B.coli in one Cubic Centimeter		
							10cc.	1cc.	0.1cc.	Turbidity. ppm.
8-9	Tap down town, Filter Plant					22				10
8-9	P.P.	-	-	-	-	45	-	-	-	10
8-10	Tap down town	-	-	-	-	16	-	-	-	10
8-10	Filter Plant P.P.	-	-	-	-	38	-	-	-	10
8-13	Tap down town	-	-	-	-	49	-	-	-	0
						37	-	-	-	0
8-13	"	" -	" -	-		12	-	-	-	0
						⊕ 18	+	-	-	0
8-14	"	" -	" -	-	-	85	+	-	-	40
						67	-	-	-	50
8-15	"	" -	" -	-	-	54	-	-	-	Trace
						58	-	-	-	11
8-16	"	" -	" -	-	-	12	-	-	-	0
						37	-	-	-	0
8-17	"	" -	" -	-	-	36	-	-	-	10
						26	-	-	-	0
8-18	"	" -	" -	-	-	15	-	-	-	0
						8	-	-	-	0
8-19	"	" -	" -	-	-	18	-	-	-	0
						14	-	-	-	10
8-20	"	" -	" -	-	-	5 14	-	-	-	Trace
						10	-	-	-	0
8-21	"	" -	" -	-	-	47	+	-	-	0
						22	-	-	-	0
8-22	"	" -	" -	-	-	15	-	-	-	0
						7	-	-	-	10
8-23	"	" -	" -	-	-	21	-	-	-	0
						42	-	-	-	0
8-24	"	" -	" -	-	-	16	-	-	-	0
						26	-	-	-	Trace
8-25	"	" -	" -	-	-	5	-	-	-	0
						9	-	-	-	0
8-26	"	" -	" -	-	-	11	-	-	-	0
						6	-	-	-	0
8-27	"	" -	" -	-	-	55	-	-	-	0
8-28	"	" -	" -	-	-	28	-	-	-	0

⊕ Taken at Grocery store conditions bad.

The total number of bacteria per cubic centimeter is below 100 in all samples analysed and B. coli are reported in only three samples. A turbidity of 40 parts per million or more is reported twice, 9 samples had turbity ranging from 10 to 40 and on three occasions samples were marked as having a trace. In considering these results it is well to bear in mind that the typhoid fever epidemic was at its height during August and that the Water Company was most likely bending every effort to clarify and sterilize the water. The most significant feature of these reults is the agreement between the high total count, the presence of B. coli in the 10 c.c. sample, and the high turbidity on August 14th. The presence of B. coli in the sample taken on this day together with the fact that the high turbidity was accompanied by a high total bacterial count is important as showing that the organic matter in the occasional high turbidity water oxidizes a part of the chlorine and renders the average dose added ineffective as a sterilizing agent.

All the evidence regarding the relation of the city water supply to the typhoid fever epidemic was contained in the foregoing tables when Dr. J. G. Wilson, Assistant Surgeon, U. S. Public Health Service arrived in Leavenworth August 16th to take charge of the public health activities in the Extra Cantonment Zone around Fort Leavenworth. Dr. John J. Sippy had

made a report on the typhoid fever situation in which it was pointed out that the first outbreaks of typhoid fever occurred co-incident with the flood stages of the river in February, and continued through March and April while the river was still having periodic rises. The general distribution of the first cases over the city and the fact that no common carrier, such as milk, food, ice, etc., was implicated led Dr. Sippy to have grave suspicions regarding the sanitary quality of the city water. The fact however that the Federal Prison, using unfiltered water, did not have a case of typhoid fever among the 1600 prisoners, 75 per cent of whom were in the susceptible age had some effect in weighing the evidence against the city water at that time.

Dr. Wilson also had at his service a report made in August by Mr. Harold Streeter, Sanitary Engineer, U. S. Public Health Service. In this report a survey of the water situation is given and the following conclusions drawn from his inspection:

"The logical conclusion to be reached from the above survey seems to be that, in spite of the existence of analytical data a large part of which are favorable to the present process, the plant as now arranged and operated is a highly insecure safeguard and the public water supply furnished the city is a constant source of potential danger to the consumers. It is possible and indeed probable that bodies of insufficiently purified water more or less frequently reach the city mains, their influence

extending throughout the entire distribution system or various parts of it, according to draft conditions prevailing.

"The logical remedy for the above situation is a thorough modernization of the construction and operation of the present plant, including, if necessary, the installation of rapid sand filters. It is the writer's opinion that filters will prove necessary to insure beyond a doubt the safety of the city supply, no matter what benefits may be afforded by immediate improvements to the present plant. Such immediate improvements, which are both practicable and urgently needed, may be summarized in the following recommendations:

1. The immediate installation of a properly ~~trained and~~ equipped laboratory at the plant.
2. The immediate securing of a properly trained and qualified man to exercise constant supervision over the operation of the plant.
3. The installation of (a) a suitable recording and indicating meter to measure the flow of water through the plant, and (b) a modern, efficient dosing apparatus for administration of the coagulant.
4. Constant, efficient, and thorough control by the above supervisor over the entire purification process, with no division of authority in this respect.

5. A series of thorough tests of the present process modified as above recommended, to be conducted under the supervision of the State Board of Health, for the purpose of determining whether the plant effluent is uniformly safe under all conditions of plant loading, seasonal and pollutional. The information thus gained, and which is now lacking, will determine whether further measures are necessary.

"The writer has been assured by authorized representatives of the local water company that all of the above recommendations will be carried out at once, these recommendations having been made at the request of the Secretary of the State Board of Health".

RESULTS OBTAINED SINCE THIS INVESTIGATION STARTED SEPTEMBER 1ST.

A National Red Cross Unit was also detailed to this Extra Cantonment Zone and reported September 1st. A laboratory was equipped at the high school and the first analyses of the city water made on September 17th. While the apparatus for the laboratory was being assembled a thorough survey was made of the treatment plant at the pumping station and the high service storage reservoir at Pilot Knob. The information gained at this time has already been given in an earlier part of this report. The results obtained from September 17th to November 1st are given in the

following table and included among these results are those obtained by Dr. Aikin in August.

TURBIDITY AND BACTERIAL ANALYSES OF CITY WATER

1917	Source	Total bacteria per C.C. Agar 37°C.	No. of 10 cc Samples of 5 that are + 24 Hrs.	+ 48 Hrs.	Confirmed Endo 24 Hrs	Confirmed Broth 48 Hrs.	Coli in 1 cc. 24 Hrs	Coli in 1 cc. 48 Hrs.	Coli in 0.1 cc. 24 Hrs.	Coli in 0.1 cc. 48 Hrs.	Turbidity	Remarks
8.21	Tap at Becker's Pop Works 10:30 AM	7	0	3	0	0	-	-	-	-		
8.22	Tap at Hamilton Cleve Co. at 9:00 AM	3	0	4	0	0	-	-	-	-		
8.23	Tap at Planters' Hotel 1:00 PM	5	0	4	0	0	-	-	-	-		
8.25	Pilot Knob Storage Res. 5:00 PM	126	0	5	0	0	-	-	-	-		
9.17	Raw Water Low Lift Pump	1334	5	5	2	2	-	+	-	+		
9.17	Same	1128	5	5	2	2	-	+	-	+		
9.21	Same	5000 +	5	5	5	5	+	+	+	+		
9.17	Primary Settling Basin	323	5	5	2	2	+	+	-	+		
9.17	" " "	2650										
9.17	First Secondary Basin	1310										
9.17	N.W. Corner Second Secondary Basin	565										
9.17	Same	305										
9.17	Middle North Side Second Secondary Basin	670										
9.24	Lab. Tap High School	33	0	5	2	2	-	+	-	+		
9.25	" " " " 2:30 PM	775	5	5	2	2	+	+	+	+		
9.25	" " " " 3:45 PM	980	5	5	2	2	+	+	+	+		

TURBIDITY AND BACTERIAL ANALYSES OF CITY WATER

1917	Source	Total Bacteria per C.C. Agar 37°C.	No. of 10 cc Samples of 5 that are + 24 Hrs.	+ 48 Hrs.	Confirmed Endo 24 Hrs.	Confirmed Broth 48 Hrs.	Coli in 1 cc. 24 Hrs.	Coli in 1 cc. 48 Hrs.	Coli in 0.1 cc. 24 Hrs.	Coli in 0.1 cc. 48 Hrs.	Turbidity	Remarks
9.26	Lab. Tap High School 3:25 PM.	615	5	5	2	2						
9.26	" " " " 4:15 PM.	570	5	5	2	2	-	+	-	-		
9.27	" " " " 2:30 PM.	715	5	5	2	2	+	+	+	+		
9.29	" " " "	17	2	4	2	1	-	-	-	-	35	
9.30	Pilot Knob Storage Reservoir 3:00 PM.	67	0	2	2	2	-	+	-	+		
9.30	Same	45	0	2	2	2	-	+	-	+		
10.1	Lab. Tap High School 1:30 PM.	25	2	3	3	2	-	-	-	-		
10.2	Tap at 410 Walnut St. 11:00 AM.	20	1	4	2	2	-	-	-	-		
10.2	Lab. Tap High School 1:30 P.M	32	1	4	0	0	-	-	-	-	30	
10.3	" " " " 3:00 PM.	38	0	1	0	0	-	-	-	-	30	
10.4	" " " " 8:30 AM.	62	0	4	1	0	-	-	-	-	15	
10.5	" " " " 3:00 PM.	8	0	1	0	0	-	-	-	-	25	
10.6	" " " " 5:00 PM.	17	4	5	3	3	-	-	-	-	30	
10.8	" " " " 8:30 AM.	39	1	4	3	3	-	-	-	-	15	
10.9	" " " " 8:30 AM.	32	0	3	2	2	-	-	-	-	20	

TURBIDITY AND BACTERIAL ANALYSES OF CITY WATER

1917	Source	Total Bacteria per c.c. Agar 37°C.	No. of 10 cc Samples of 5 that are + 24 Hrs.	+ 48 Hrs.	Confirmed E. coli 24 Hrs.	Confirmed Broth 48 Hrs.	Coli in 1 c.c. 24 Hrs.	Coli in 1 c.c. 48 Hrs.	Coli in 0.1 c.c. 24 Hrs.	Coli in 0.1 c.c. 48 Hrs.	Turbidity	Remarks
10.10	High School Tap 8:30 AM	36	4	4	4	4	-	-	-	-	20	
10.10	" " " 9:50 AM	745	3	5	5	5	+	+	-	-	1400	Building Sewer
10.10	" " " 10:15 AM	58	1	2	2	2	-	-	-	-	140	
10.11	" " " 4:00 PM	13	0	2	0	0	-	-	-	-	15	
10.12	" " " 3:00 PM	130	0	2	1	0	-	-	-	-	10	
10.13	" " " 4:00 PM	157	0	2	0	0	-	-	-	-	15	
10.15	" " " 5:00 PM	17	0	1	0	0	-	-	-	-	20	
10.16	" " " 4:00 PM	12	0	2	0	0	-	+	-	-	20	
10.17	" " " 4:00 PM	11	0	0	0	0	-	-	-	-	15	
10.19	" " " 3:30 PM	22	0	1	0	0	-	-	-	-	15	
10.20	" " " 4:00 PM	5	0	0	0	0	-	-	-	-		
10.22	" " " 4:00 PM	28	0	3	2	2	-	-	-	-	115	
10.23	" " " 5:00 PM	12	0	1	0	0	-	-	-	-	15	
10.23	Federal Prison Tap 11:00 AM	38	0	5	5	1	-	-	-	-		
10.24	High School Tap 3:00 PM	6	0	2	1	1	-	-	-	-	20	
10.25	" " " 3:30 PM	38	0	0			-	-	-	-	20	

TURBIDITY AND BACTERIAL ANALYSES OF CITY WATER

1917	Source	Total Bacteria per C.C. Agar 37°C.	No. of 10 cc Samples of 5 that are + 24 Hrs.	+ 48 Hrs.	Confirmed Endo 24 Hrs	Confirmed Broth 48 Hrs.	Coli in 1 cc. 24 Hrs.	Coli in 1 cc. 48 Hrs.	Coli in 0.1 cc. 24 Hrs.	Coli in 0.1 cc. 48 Hrs.	Turbidity	Remarks
10.25	Federal Prison Tap 10:00 AM.	3	0	4	4	4	-	-	-	-	30	
10.26	High School Tap 3:00 PM.	113	0	0	0	0	-	-	-	-		
10.26	" " " 6:00 PM.	20	0	2	0	0	-	-	-	-	30	
10.27	" " " 1:30 PM.	625	0	1	0	0	-	-	-	-	25	
10.27	" " "	135	0	1	0	0	-	-	-	-	25	
10.28	" " " 10:00 AM.	268	0	0	0	0	-	-	-	-	20	
10.28	" " " 3:00 PM.	675	0	2	0	0	-	-	-	-	25	
10.29	" " " 8:00 AM.	540	0	3	2	2	-	-	-	-	120	
10.29	" " " 3:00 PM.	35	0	1	1	1	-	-	-	-	40	
10.36	" " " 10:00 AM.	21	0	2	1	1	-	-	-	-	30	
10:30	" " " 3:00 PM.	15	0	1	0	0	-	-	-	-	15	
11. 1	" " " 4:00 PM.	11	0	0	0	0	-	-	-	-	30	
11. 2	" " " 3:00 PM.	18	0	-	0	0	-	-	-	-	30	
11. 3	" " " 4:00 PM.	11	0	2	0	0	-	-	-	-	25	

An examination of the results given in the table shows very clearly the present status of the water situation and what it has probably been in the past. The samples taken at the intake in the river show very great contamination and likewise all the samples taken from the different settling basins. After treatment with the liquid chlorine the results run within the standard set by the U. S. Public Health Service except at certain intervals. On September 24th the total number of bacteria per cubic centimeter was low and B coli were reported in two of the five 10 c.c. samples. In the two samples examined on the 25th and 26th and the one on the 27th the total count is very high and all the samples had gas at the end of the 24 hours and the presence of B.coli was confirmed in all of the samples. An examination of the diary for that period shows that on September 24th the first secondary settling basin was drawn down and a part of the mud flushed out. Removing this basin from the service cut down the storage period of the water treated with aluminum sulphate to considerably less than 24 hours which was not sufficient to remove the light alum floc and the finely divided silt. On September 27th the final settling basin was closed down, drained and cleaned, and again the water from the primary basin after treatment with alum received less than 24 hours sedim-

entation. Sometime during this period of flushing out the mud in the basins water got by that did not receive sufficient chlorine to kill bacteria. It is quite possible that only a small amount of the water pumped to the mains at this time was insufficiently treated but at some time during this period a portion of the water did escape the usual degree of sterilization. It is important to note at this time that the primary settling basin had almost 50 per cent of its capacity filled up with mud and that the water, with one secondary basin out of operation, was receiving less than three days storage before going into the city mains. If all the water pumped on the 24th and 27th had been insufficiently treated it would not have shown such a low count on the 28th. The sample analysed on the 10th at 9:50 a. m. was taken when water from fire plugs was being drawn in the neighborhood from which the sample was taken and this sample is not representative. A sample collected less than 30 minutes after the sample just referred to showed no B. coli present and the total count was low.

~~After this temporary lapse in efficiency~~ the plant produced a water low in total number of bacteria and with no B. coli present up to October 26th, ~~straight sixteen~~ except on the 6th and 8th, when B. coli were found in three of the five 10 cc samples. On the 26th the primary basin was taken out of service to

remove a part of it the mud on the bottom and the river water was pumped direct to the first secondary basin. The sample collected at 3 P. M. on the 26th had 113 bacteria per cubic centimeter and no B. coli present and on the following days the total number continued high but no B. coli were found. The primary basin was out of service from 5 A. M. October 26th to 6 A. M. October 28th. These results bear out the contention made previously in this report when the analyses of the water following the cleaning of the first secondary basin were discussed. The raw water entering the first secondary basin short circuited this basin through the opening into the second secondary basin which is in the same end of the basin as the inlet to the first secondary basin, and a part of the water remained in storage less than 12 hours only as shown by the analyses. If these basins, and particularly the first one, were properly baffled the water would remain in storage somewhere near the theoretical period of about 36 hours and more of the suspended particles that carry the bacteria would be removed.

The turbidity increased while the primary basin was out of operation from 15 to 20 parts per million to 25 to 30 parts per million and the sediment producing the turbidity could easily be seen over the bottom of a gallon bottle standing for 24 hours.

There was only a trace of turbidity in the samples of water collected from the filtered water delivered to Fort Leavenworth

and no sediment was ever found in samples stored for days in the laboratory. The filtered water represented the ideal for drinking water. The bacterial count in all the samples tested was below 25 and no B. coli were found in any of the 10 c.c. samples. At the Post laboratory frequent bacterial analyses have been made, and Lieut. Col. Chas. F. Craig, U. S. A., reported that the water was uniformly satisfactory.

The turbidity of the samples drawn at the Red Cross laboratory was determined after September 29th. The method used consisted of comparing the sample of water with turbidity standards made up with suspensions of precipitated fuller's earth in distilled water. This method is recommended by the American Public Health Association and the turbidity of the standards was very similar to the turbidity of the tap water. At no time was the turbidity less than 10 parts per million and on one occasion it ran as high as 35. The high results on the 10th at 9:50 and 10:15 A. M. were directly due to the disturbance in the mains on account of the heavy draft at fire plugs on an adjoining street. At the pumping station it was observed that the chemical floc produced by adding alum to the water did not completely settle out in the settling basins and was going into the force mains of the city. It was this floc that caused the turbidity and it could be easily seen over the bottom of the

bottles in which the turbidity was read after the bottles remained quiescent for 48 hours.

CONCLUSIONS AND RECOMMENDATIONS.

This investigation was begun September 1st and ended November 1st. During this time the treatment plant at the pumping station was under constant observation and since September 17th bacterial analyses and turbidity determinations have been made practically daily. Previous to September 1st two special reports on the water situation in Leavenworth were made, one by a representative of the State Board of Health and one by a sanitary engineer of the U. S. Public Health Service. In addition to the two reports referred to above the State Board of Health had analyzed weekly samples as far back as January 1st, 1917, and the Water Company, through a commercial laboratory, had made weekly analyses extending back to the first of the year. The Water Company also engaged a bacteriologist to make daily bacterial and turbidity tests during the month of August. It will thus bee seen that a fairly complete history of the water furnished Leavenworth is at hand for the last ten months. The records of the Commercial Company that made the tests for the Water Company and those from the State Board of Health laboratory agree as well as could be expected and neither show that the water furnished the city was badly contaminated for long periods at any time. The analyses made for the Water

Company in the weekly tests except the total count were not carried far enough to be conclusive but they were sufficient to indicate gross pollution. The State Board of Health results are more reliable and probably indicate, as far as weekly analyses can prove anything, the true condition of the water during the past 10 months. The special daily examinationscovering August did not comply with the standard procedure established by the U. S. Treasury Department, but here again the analyses as made would have indicated any extensive pollution. The method of analyzing samples at the Red Cross Laboratory since September 17th., and before that time by Dr. C. V. Aiken in the laboratory car Wyman, and the interpretation of the results have conformed to the Treasury standards, and the results, already given, illustrate just what the present treatment plant can accomplish.

Reviewing all the results obtained since January 1st. of this year it will be observed that the plant at times has produced a water that comes within U. S. Treasury bacterial standard for interstate carriers. It will also be observed that there are times when the plant produces water ~~not only not coming within the Treasury standard but~~ far below the standard.

The variation in the quality of water produced has not always corresponded to changes in the character of the raw river water treated, and this is to be expected from the discussion already given regarding the design and operation of the treatment plant. With a plant poorly designed and with practically no attention given to the operation it is not within reason to expect anything but erratic results.

The best example of the failure of the plant to give satisfactory results was at the time when the basins were cleaned on September 25th, and 27th, and again on October 26th and the days following when the primary basin was out of service. During this period the water drawn from the mains was turbid and continued so after the bacterial results again were satisfactory. That the water delivered to the city has been turbid many times during the last ten months for long periods of time is beyond any doubt. Reports from reliable residents, from schools and business men establish this point beyond question and the results obtained at the Red Cross laboratory since September 17th show very clearly that the water during the period since that time never had a turbidity less than 10 parts per million and has been as high as 35. At three different times since September 1st and in particular on October 20th and a few days following, the water drawn from the mains had a very noticeable odor. At this time the first water drawn from the taps in the morning was very turbid but it continued so/ only for a few minutes. The cause of the odor and turbidity was no doubt the finely divided alum precipitate mixed with particles of mud that had not settled in the basins but were precipitated in the pipes while standing over night.

The very obvious conclusion to be drawn from all the data given and discussed is that the treatment plant of the Water Company has lapses when B. coli are not killed by the chlorine added, and that the water is turbid many times during the year for long periods of time, the turbidity varying from 10 to 35

parts per million. While the turbidity is caused by particles that do not affect the health of the people in the amounts found in the samples, nevertheless a turbidity even as low as 10 p.p.m. in water is plainly discernible, and people will continue to use the clear well water from their back yards instead of a sterilized cloudy water although the well water is most frequently very badly contaminated. Water should be free of turbidity and odor as well as bacteria in order to be classified as potable.

The analyses from the Red Cross laboratory showing the presence of B. coli in many of the samples drawn from the city water supply from September 17th. to November 1st., and the fact that the water was more or less turbid during the entire period, are ample reasons for urging that immediate steps be taken to obtain the highest efficiency out of the plant as now designed and that the whole treatment plant be re-designed to conform to modern practice in treating a water similar to that in the Missouri River.

In order to increase the efficiency of the treatment plant at the pumping station the writer wishes to indorse and add more emergency measures to those previously proposed in Mr. Streeter's survey in August and recommended before that time by the State Board of Health. These emergency measures should have been installed upon the first request from the State Board of Health as they have all been admitted as necessary by the officials of the Water Company, and are quite evident to anyone familiar with modern water treatment plants.

For the sake of convenient reference the emergency measures which should be immediately undertaken may be summarized as follows:

First. An emergency liquid chlorine or hypochlorite apparatus should be installed and maintained in good working order to supplement the liquid chlorine machine now in use.

Second. A modern apparatus in duplicate should be installed to regulate the amount of alum added to the water at the two points of application.

Third. The amount of water pumped daily should be determined either by installing a meter or by rating the pumps by the amount of water drawn down in the secondary basins when the inlet to these basins is closed. This is necessary to regulate the alum and chlorine treatment.

Fourth. Baffles should be arranged in front of the inlet to the first secondary basin to cause a thorough mixing of the alum with the water entering the basins.

Fifth. The mud in the primary basin should be removed at once. Practically one-half of the effective settling capacity is now filled with mud.

Sixth. All the mud in the first secondary basin should be removed.

Seventh. The storage reservoir at Pilot Knob should be emptied and thoroughly cleaned.

Eighth. A barbed wire fence at least eight feet high should enclose Pilot Knob reservoir, with a fine mesh chicken wire fence three feet high around the bottom. The gate to this reservoir should be kept locked. The ground inside the fence should be seeded down with grass, and the weeds cut, and a competent watchman engaged to guard the reservoir.

Ninth. The laboratory at the office of the Water Company should be fully equipped for bacteriological work and the man in charge given ample opportunity to study and develop a routine procedure for making daily tests of the raw and treated water. He should also be given complete charge of the operation of the treatment plant.

Tenth. The treatment plant should receive more attention, and when basins are taken out of service for removing the mud, etc., work should be carried on vigorously and without interruption until finished.

All the suggestions given above were recommended by the writer after the first survey of the plant, and they were urged upon the Water Company by the State Board of Health in the summer, and by Mr. Streeter in August, but it was only recently that any attempt has been made to carry them to completion. Modern plants and especially those without filters have all this equipment and take all the precautions named above to safeguard the water pumped into their water mains. After the treatment plant has been improved to the extent of the suggestions made above other

safeguards must be thrown about the plant to insure the very best results. While not classed as emergency they are very important and may be classified as follows:

First. Those that deal with the operation.

(a) Practically all the mud in the first settling basin should be removed three times per year, and the mud on the sides of the basin washed down at least five feet below the outlet in use once per month.

(b) The mud washed from the basins should go into the river below the intake and not immediately above as it does now.

(c) The mud from the first secondary basin should be washed out three times per year and the sides of the basin washed down once per month.

(d) The second secondary basin should be thoroughly cleaned twice per year and the sides washed each month.

(e) The floating scum that collects over the surface of the secondary basins should be removed daily.

Second. Those that deal with construction.

(a) Either a partition wall in the primary basin or an additional reservoir should be constructed to insure efficient removal of suspended matter when it becomes necessary to close down the primary basin to remove the mud. With the primary basin out of operation the storage period is less than 48 hours. This plus one-half

of the primary basin would give a little more than 72 hours.

(b) A baffle wall should be placed in the first secondary basin to insure the maximum detention by forcing the water to travel the full length of the basin and return.

Even with the treatment plant remodeled and operated as suggested above, experience in treating water in other cities on the Missouri River and other rivers has proved that a uniformly clear, odorless, and bacterially safe water can not be obtained without prolonged storage in reservoirs or filtration through sand filters.

The history of the water situation since September 1st. and the reports from reliable sources previous to that time show quite plainly that the water delivered to the city has been turbid for a large part of the year and has given off odors that prevented many people from drinking the water. The data obtained since September 17th. and from other sources before that time for the period as far back as January show that at times the water contained B. coli and bacteria in amounts not permissible in a safe drinkingwater. The changes in construction and operation recommended will improve the quality of the water to some extent but the plant even if remodeled and operated to the best advantages will fail to give the clear and bacteria-free water that the present filters at the pumping sta-

tion are producing for the Fort. It is therefore recommended that any plans drawn for remodeling the present plant be made to fit in with the design for the installation of sand filters and that plans for filters be prepared in the near future. One of the most serious objections encountered in the effort to close contaminated wells was the fact that the city water was turbid, had a bad odor at times and the people did not want to use it. Clean and pure water is as essential to the well-being of a city as clean and pure milk.

The Leavenworth City and Fort Leavenworth Water Co. is now producing and delivering to Fort Leavenworth a pure and wholesome water while the City of Leavenworth accepts a water that is turbid and has an odor a large part of the time and frequently contains bacteria in larger numbers than is permissible in a safe drinking water. Filters will remove the turbidity and with it the odor and they will serve as a safeguard against those times when the plant as now constructed or remodeled lapses and bacteria get into the city mains in large numbers. There are but very few cities in this country today that do not demand filtration of their water supply where the raw water is as turbid and badly contaminated as the Missouri River water is.

The most satisfactory solution for this water question is for the city to purchase the plant and remodel and operate it as outlined above and thereby settle once and for all the many questions of service and operation that have been before the public mind so long. Water works should be owned and operated by the city for

service only and not for profit, and in view of the present attitude of the people toward the Water Company and in turn the attitude the Water Company has assumed toward the public, it is herebyrecommended that the City of Leavenworth initiate a movement to take over the Water Company's rights and thereby pave the way for a modern municipally-owned water system.

ORDINANCE NO. 3738

Ordinance relating to privies and cesspools and connection with sewers, in the City of Leavenworth and providing penalties for the violation of the provisions thereof.

Be is ordained by the Board of Commissioners of the City of Leavenworth, Kansas:

Section 1. Cesspools, vaults: No person firm, or corporation shall construct, permit or maintain a privy vault on any lot or premises where there is a public sanitary sewer and city water in any street, alley or highway adjoining such lots or premises except as provided for in the following section.

Section 2. Whenever there is a sewer in the street, alley or highway adjoining property where people live, work, or congregate for any purpose and it is impossible on account of limited space in the buildings to install toilet facilities in the buildings and there is city water adjoining the premises and available, outside toilets may be connected direct to the sewer by the owner or owners of the property if frost proof flushing service is installed. In no case will direct connections to the sewers be permitted in new installations where there is city water available for outside toilets except as outlined above and all services now in use on such premises without flushing service devices must be discontinued within 30 days after the passage of this ordinance.

Section 3. Where there is a sewer in the street, alley or highway adjoining property where people live, work or congregate for any purpose and there is no city water adjoining the premises and available, water tight privy vaults or cesspools

shall be constructed according to the provisions of this ordinance relating to privies and cesspools and no connection from the privy vault or cesspool to the sewer will be permitted.

Section 4. Every privy vault located on premises described under section 1, shall be abandoned within 30 days after the passage of this ordinance or 30 days after a new sewer is laid and all abandoned privies and cesspools must be thoroughly cleaned and filled with ashes, cinders, earth or other material not subject to decay or liable to cause a nuisance from any cause whatsoever.

Section 5. No person, firm or corporation or institution of any kind shall hereafter construct, establish, or remodel a privy building or vault without a written permit from the city health office and upon completion of the construction of a new privy building or vault or the remodeling of an old one, it shall be inspected and a written approval obtained from the health officer before it can be used. Such inspection shall be made by the city health department within 48 hours beginning at 8 a. m. after receiving written notice that is is ready for inspection.

Section 6. The side walls and bottoms of all privy vaults shall be made of any of the following materials; water proof brick layed in cement mortar, concrete, or concrete blocks layed in cement mortar. The sides and bottom must be smooth, even and water tight.

Section 7. All privy vaults hereafter constructed must be at least 3-1/2 feet wide (front and rear) 3 feet long and 6 feet deep. The walls must extend 6 inches above the ground surface and the privy building joined tightly to the walls. The sides of the buildings shall extend six inches below top of vault wall. 44 A ventilating pipe at least four inches square made of either wood

or iron shall extend through the roof and above to the height of at least 2 feet above the privy building, and covered at the top with a brass or copper wire fly screen. The seat covers shall be self closing and the seat top removable for cleaning. The door of the privy building must be made self closing by means of a spring, weight or other device and must not be allowed to remain open at any time.

Section 8. All privy vaults shall be disinfected whenever so ordered by the city health officer

Section 9. No wash water, roof water, kitchen slops, or other liquid wastes, garbage, rags, tin cans, crockery, or glass shall be emptied or thrown into any privy vault.

Section 10. No bodily waste or excrets from any person suffering from typhoid fever, small pox or cholera or any other infectious disease shall be thrown or desposited in any privy vault, or cesspool without being previously disinfected in such manner as may be approved by the City health officer.

Section 11. All privy vaults without curbing or with foul or rotten curbing, or inadequate, or partially caved, or otherwise defective in the judgment of the city health officer and all privy buildings too old or too dilapidated to be made to conform with the requirements of this ordinance, and all cesspools without curbing, or inadequate either in size of cover, or caved, or in any manner dangerous to the public health, shall be condemned by the city health officer and a new privy vault, privy building or cesspool shall be constructed by the owner or his agent within not less than 30 days from the date of condemnation. In either case, notice of condemnation must be

posted on the premises and a copy served on the owner of his agent, or left at the residence or office of either.

Section 12. No person, firm or corporation shall abolish, abandon, or neglect any privy vault containing excrement, filth or other offensive matter, or fill up any such privy or vault upon any premises owned or occupied by such person or persons, or any premises whatsoever, unless such filth or excrement shall first have been removed and the pit filled with ashes, cinders or clean earth, etc.

Section 13. All contractors or other persons employing men in constructing buildings, street improvements or other similar work shall provide and care for such temporary privies as will meet the approval of the city health officer.

Section 14. It is the duty of the owner or owners, or agent of property to keep all privy vaults and privy buildings on property owned or managed by them, clean, and to properly clean them whenever notidfied by the health officer to do so, and any expenses incurred in cleaning vaults or abating any nuisance shall be paid by the person, firm or corporation owning the premises where the said privy vault or privy building has been ordered cleaned by the city health officer.

Section 15. No building shall be used as a dwelling house unless the same is provided with a privy vault and building or is properly connected with a cesspool or sewer.

Section 16. It shall be unlawful for any person, firm or corporation to clean a privy vault or cesspool until the equipment for cleaning said privy vaults or cesspools has been

examined and approved by the city health officer. Written approval by the city health officer is sufficient guarantee of a proper equipment to perform the work but the city health officer may revoke the privilege of cleaning privy vaults or cesspools at any time if the apparatus is not maintained in a satisfactory condition.

Section 17. Containers to be water tight: All carts, receptacles, containers, and implements used in the removal of the contents of any vault, sink or cesspool shall be strong, tight, and so constructed that no part of the contents shall leak or fall therefrom, and such carts, receptacles, containers and implements kept covered and protected so that flies shall not have access thereto or to the contents thereof.

Section 18. Cleaning of containers after use: All carts, receptacles, containers and implements used in removing the contents of any vault, sink or cesspool shall be kept in an inoffensive and sanitary condition. Such carts, receptacles, containers and implements shall be thoroughly washed inside and outside after each use and when not in use shall be stored and kept in some place where they shall not become offensive or create a nuisance.

Section 19. The time of the day or year when cesspools or privy vaults shall be leaned will not be limited except in cases where a nuisance will be created by cleaning them in the day time and in all cases the city health officer shall be the judge. In every and all cases where the city health officer orders a vault or cesspool cleaned at night the time of cleaning will be limited to the time between 9 p. m. and 5 a. m.

Section 20. The time, place and manner of cleaning privy vaults and cesspools and the disposal of the contents of the same shall be determined by the city health officer and a written permission will be given designating the time place and manner of removable and disposing of said wastes.

Section 21. The City Health Officer or his representatives shall have the right to enter upon any premises and inspect the sanitary conditions therein.

Section 22. Whoever shall violate any provision of this ordinance shall, upon conviction, be punished by a fine of not less than $5.00 or more than $25.00, or in default of payment of fine, by imprisonment in jail for not less than 5 days nor more than 30 days, or by both, at the discretion of the judge having jurisdiction over the same, and each days violation of same shall constitute a separate offense.

Section 23. All ordinances or parts of ordinances in conflict herewith are hereby repealed.

Section 24. This ordinance shall take effect and be in force from and after its passage, approval and publication.

Approved_____1917.

_____
Mayor

Attest:_____City Clerk

Passed_____

Published_____

The Leavenworth Times.

Ordinance No. 3737

An ordinance relating to maintenance and disposal of manure in the City of Leavenworth, Kansas.

Be it ordained by the Board of Commissioners of the City of Leavenworth, Kansas:

Section 1. Every person, persons, firm or corporation owning, leasing, or using any stall, stable, shed, barn, or other place in which any horse, horses, cattle, fowl, birds, or other domestic animal or animals shall be kept, or any other place in which any manure or refuse from horses, cattle, fowl, birds or other domestice animals may collect or accumulate, shall at all times keep or cause to be kept in a cleanly and healthful condition such stalls, stables, sheds, barns, and the yards and appurtences thereof and no offensive smells shall be allowed to escape therefrom.

Section 2. Every stall, stable, shed, barn, etc., hereinbefore mentioned shall be provided with a properly constructed manure vault or box which shall be water tight at all times except that where a concrete container is constructed, a drain pipe from the bottom to a sanitary sewer may be installed to carry away the liquid portion of the manure. A heavy weight strainer must be placed over the outlet from the manure box and a trap placed in the sewer line. The box shall be covered with a fly proof lid which shall be kept closed at all times except when it is necessary to open said box to deposit or remove the manure from said receptacle or box. Under no circumstances shall any manure be deposited in any place or receptacle other than in a vault or box container as hereinbefore described.

Section 3. No manure removed by any vault, pit, or bin, or any other place where said manure has accumulated shall be deposited in any place within the limits of the City of Leavenworth without a permit from the city health officer. When said permit is issued the person removing manure must be governed by the provisions thereof. Nothing in this section shall apply to the distribution and placing of manure on gardens, private lawns and parks if said manure is thoroughly decomposed so that its distribution will give rise to no offensive or obnoxious odors.

Section 4. It shall be unlawful for any person, firm or corporation to haul, transport, or convey or to cause or permit to be hauled, transported, or conveyed any manure of stable, barnyard, or poultry yard refuse upon or along any public street, alley or other public place in the city of Leavenworth except in a vehicle, box or other receptacle so constructed and maintained that such manure, or stable, barnyard, cow yard, or poultry yard refuse shall not escape from any vehicle box, or other receptacle in, into or upon any such public street, alley or other public place.

Section 5. Any person, firm or corporation offending against or failing to comply with any or all of the provisions of this ordinance shall be guilty of a misdemeanor and upon conviction shall be fined not less than $5.00 and no more than $20.00

Section 6. All ordiances or parts of ordinances in conflict with this ordinance are hereby repealed.

Section 7. This ordiance shall take effect and be in force from and after its passage, approval and publication.

City Clerk

Attest:_____ Approved_____ 1917

Passed_____

Published_____

The Leavenworth Times

50

_____ Mayor

ORDINANCE RELATING TO THE COLLECTION AND
Disposal of Garbage.
(This ordinance has not yet been presented to the Board of Commissioners).

Section 1. Whenever and wherever the word garbage shall be used in this ordinance it shall be held to include all kitchen and table refuse, offall, and vegetable matter that attends the preparation, decay, dealing in, or storage of meats, fruits, fish, foul, game or vegetables, and the tin and glass containers of food, subject to the restriction in section 2. [Copy sentence on note attached]

Section 2. The tin and galss containers that have been used for storing food products shall come within the meaning of the term garbage only when said containers have been used in private residences or boarding houses. The term garbage shall not include scrap, broken or imperfect food containers that result from the manufacture of said containers nor will it include any tin or glass containers from hotels, restaurants, drug stores, soda fountains, bottling works or any place where food products or liquid drinks are sold either by wholesale or retail.

Section 3. All persons, firms or corporations keeping or offering garbage for collection in the districts declared by the Board of Commissioners to be the collections districts shall provide a water-tight receptacle with proper handles and a tight fitting

cover with handle to hold all the garbage with the cover on tight for the interval between the regular collection days stated elsewhere in this ordinance. Buckets without covers, pans, boxes or any receptacle to which a tight cover is not attached shall not be permitted as containers for garbage and garbage will not be collected from containers larger than 10 gallons.

Section 4. All persons, firms or corporations keeping or offering garbage for collection shall place the containers by the side of a street, highway or alley where they may be easily accessible to the garbage collectors on regular collection days or any other days when requested to do so by the superintendent of garbage collection. The Commissioners of_____shall have the right to determine whether garbage cans shall be placed on the side of alleys or streets in ~~only~~ any block to facilitate the collections.

Section 5. The garbage shall be collected, outside the congested district, on three days each week from May 1st to October 31st inclusive and twice per week during the other months. In the congested districts, which shall be determined by the Commissioners of_____, daily collections shall be made.

Section 6. Garbage cans placed upon sidewalks of public streets or highways shall be removed immediately after the

contents of the cans or other receptacles have been removed and they shall not be placed upon or near such street or highway except upon the day the garbage is to be collected. Alleys in the rear of residences do not come within the meaning of this section.

Section 7. The Board of Commissioners is hereby authorized and empowered in behalf of the city to enter into a contract for the collection and disposing of all or a part of the garbage of the city upon such terms and conditions as may be agreed upon, for a period of not more than five years, with any suitable person, persons, firm or corporation.

Section 8. All carts, wagons or other vehicles used to carry garbage shall be provided with water tight boxes, barrels or beds and shall have tight covers which shall be used at all times to cover completely the contents of said carts, wagons or other vehicles except when loading and unloading. All such carts, wagons or other vehicles used to collect or transport garbage shall be so loaded and driven that none of the contents shall fall, spill, or leak therefrom and they shall be washed and maintained in such condition as not to give offense either when stored or hauled through the city thoroughfares.

Section 9, It shall be unlawful for any person, firm or corporation to dump or cause to be dumped any garbage as defined under sections 1 and 2 upon any street, highway, alley, lot or bank of any stream within the city limits of Leavenworth. Nothing in this section shall however be construed to prevent the Board of Commissioners from designating any place within the city limits as a place of disposing of the garbage.

Section 10. It shall be unlawful for any person, firm, or corporation to collect, remove or transport garbage from any source within the city limits of Leavenworth without first entering into a contract of obtaining a permit from the Board of Commissioners. No fee will be attached to the permit, it shall be removed on April 1st each year and no permit will be given until the apparatus for collecting and removing the garbage has been approved by the Commissioners of_____ and the permit is subject to revocation whenever any or all of the provisions of this ordinance is not compiled with.

Section 11 Any person firm or corporation who shall collect or dispose of garbage within the City limits without first entering into a contract or obtaining a permit, or who shall violate the conditions of his contract or permit, or who shall violate any of the sections of this ordinance shall be deemed guilty of a misdemeanor and shall be fined for each offense not less than $1.00 and not more than $25.00

Nothing in this section shall however be construed to include the offall from the wholesale slaughter of beef, hogs, sheep, or any animal, or from foul, game and fish, or the removal of decayed or spoiled vegetables or fruit in quantities larger than the capacity of one garbage can described under section 4.

TREASURY DEPARTMENT,
1917 LIBERTY LOAN—FORM No. 1.
LOANS AND CURRENCY.

LIBERTY LOAN.

APPLICATION FOR BONDS.

This application should be transmitted through the subscriber's bank, trust company, or other agency acting on his behalf, or it may be filed direct with the Federal Reserve Bank of his district or the Treasury Department at Washington.

Dated .....

To the Secretary of the Treasury:

According to the terms of Treasury Department Circular No. 78, dated May 14, 1917, the undersigned hereby apply for $..... par value of the 15–30 Year 3½ Per Cent Gold Bonds of the United States, and agree to pay par and accrued interest for any bonds alloted on this application. The sum of $..... is inclosed, being 2 per cent on the amount of bonds applied for (or payment in full for the one $50 or the one $100 bond applied for).

Signature of subscriber, in full, ...

Address—Number and street, ...

City or town, ...

County, ... State, ...

NOTE.—It is desirable that the following information be furnished by the applicant:

1. If full payment is to be made before final installment date indicated in the circular, what will be the date of such full payment?.....

2. If it is expected that future payments will be made by check, upon what bank or trust company will such checks probably be drawn?

Name of bank or trust company:.....

Address: .....

3. What, if any, particular denominations of interim certificates are desired?.....

4. Through what, if any, bank or other agency is this application transmitted?.....

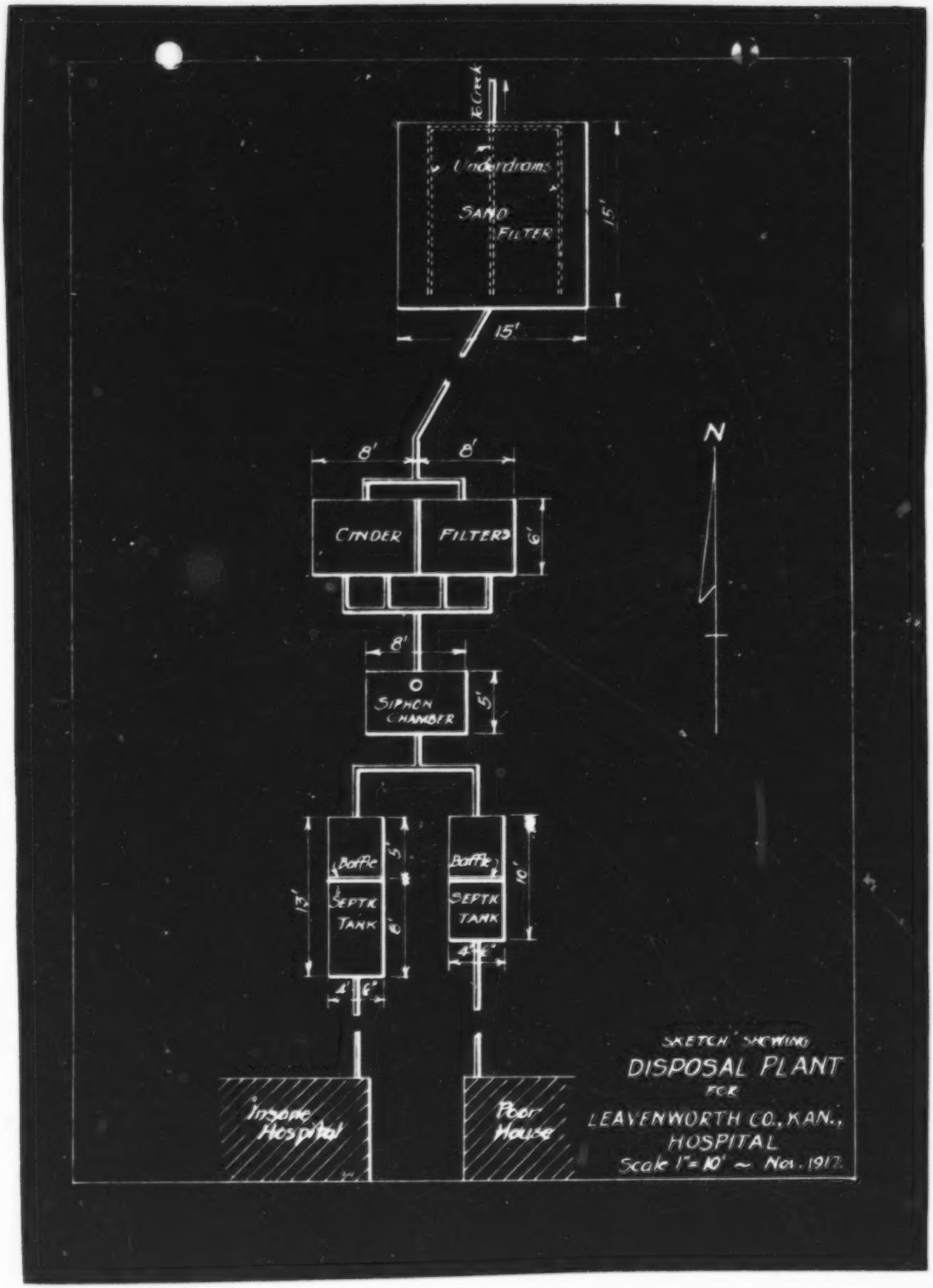
55

Report on the OPeration of the Sewage Disposal Plant at the Leavenworth County Hospital with Recommendations for Increasing the Efficiency of the Plant.

The County Hospital is located south of the city and just outside the corporation line. The patients consist of the indigent poor and the insane of the county. On October 6th. the number of patients was 47, 12 of whom were in the insane wards, and in addition there were 6 helpers, making a total of 53. There is city water at the hospital but no city sewer district nearby that can serve as an outlet for the sewage. The only means of disposing of the sewage is to discharge it into a ditch running through the north side of the property.

It was not practical to measure the amount of sewage discharged from the hospital, but from the records of the amount of water used it was found that approximately 1500 gallons of sewage were discharged daily. On account of the ditch, serving as the outlet for the sewage, having practically no water flowing in it during the summer months except during rainy weather, the county commissioners were required to install a purification plant a few years ago. This plant, as shown on the sketch, consists of two septic tanks, one for the hospital proper and one for the insane ward, a siphon chamber, and a filter bed filled with limestone averaging about 2 inches in diameter.

The septic tank receiving the sewage from the hospital proper is 10 feet long, 4-1/2 feet wide, has a working depth of 4 feet, and a transverse baffle wall 5 feet from the outlet. The tank


E Crk
Underdrains
SAND FILTER
15'
15'
8'
8'
CINDER
FILTERS
6'
8'
SIPHON CHAMBER
5'
Baffle
SEPTIC TANK
5'
8'
Baffle
SEPTIC TANK
10'
4'
6'
Insane Hospital
Poor House
N
SKETCH SHEWING
DISPOSAL PLANT
FOR
LEAVENWORTH CO., KAN.,
HOSPITAL
Scale 1" = 10' ~ Nov. 1917.

for the insane ward is 13 feet long, 4-1/2 feet wide, has an effective working depth of 5 feet, and is provided with a baffle wall across the tank 5 feet from the outlet. The effluent from both tanks flows to one siphon chamber 8 feet long, 5 feet wide and 2-1/2 feet deep. From the siphon chamber the sewage is discharged into the filter bed which is 16 feet long, 6 feet wide and filled to a depth of 4 feet with coarse stone.

The plant as operated was the cause of considerable complaint during the summer, and as it is located within the extra-cantonment zone around Fort Leavenworth, the writer was requested to make an investigation and report on methods for removing the nuisance.

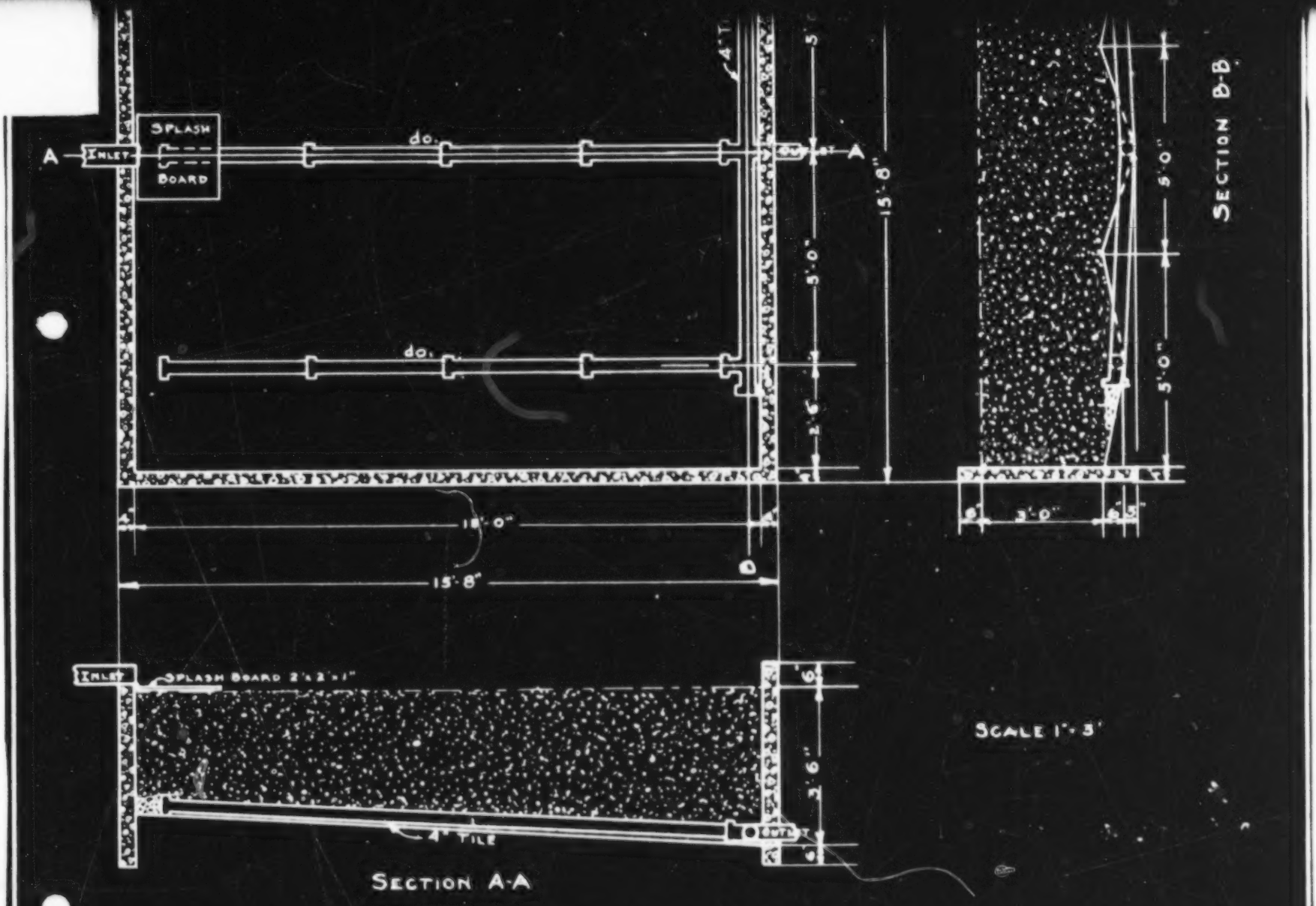
The septic tanks and siphon chamber were operated without creating a nuisance but the filter had become clogged with organic matter and as a result no oxidation was taking place and the effluent discharged into the ditch was putrescible and gave off odors that caused the complaints. The superintendent had applied lime and a strong disinfectant to the filters and along the ditch but this only had the effect of destroying the odors at the points where applied and did not prevent their development further down the ditch.

It was apparent from the first survey that the stone in the filters was too coarse to be effective as a filter. It was therefore decided to remove the stone from one-half the filter bed and replace it with cinders screened over a half-inch mesh screen. The results obtained from the analyses of the effluent from the cinder

filter were superior to those from the effluent from the stone filter but the improvement was not enough to assume that a nuisance will not arise again next summer. It was therefore recommended that a sand filter be installed early next spring, as shown on the enclosed blue print.

The depth of the sand is to be as shown on the plans or as deep as the difference in elevation between the ditch and the bottom of the cinder filters will permit. The sand should be held in place either by a cement wall or by oak planks. The sewage is to flow from the cinder filter to the surface of the sand and through it to the ditch.

The bottom of the filter should be prepared as shown in the plans. It must be smooth and evenly graded to a slope sufficient to carry all the sewage to the tile drains. The ends of the drains and the tiles themselves must be covered with coarse stone or cinders to prevent the sand from working through into the drains. Cinders screened over a half-inch screen will make a satisfactory covering for the tile provided care is observed to prevent crushing while placing them. Crushed stone 2 to 4 inches in diameter laid over the tile to a depth of 4 inches and covered with 3 or 4 inches of limestone screenings is the most satisfactory covering of the underdrainage to prevent the sand from getting into the tile.



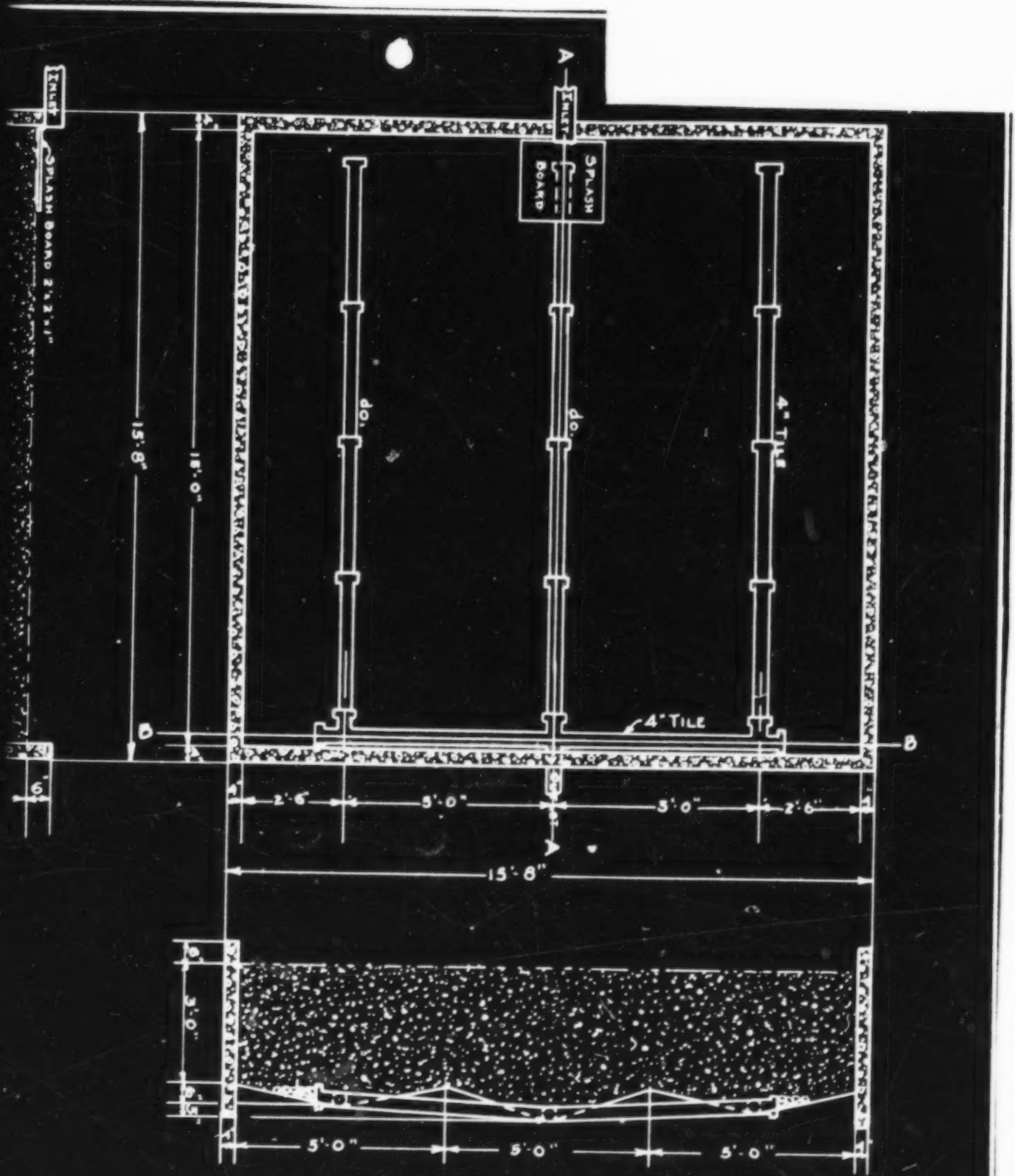
DESIGN FOR SAND FILTER-COUNTY HOSPITAL

LEAVENWORTH KANSAS-EXTRA CANTONMENT ZONE

OCTOBER 1917

DESIGNED BY H. B. Hommon

DRAWN BY H. L. Hutton


A
INLET
SPLASH BOARD
SPLASH BOARD 2'-2"
15'-8"
15'-0"
do.
do.
4" TILE
4" TILE
B
B
6"
2'-6"
5'-0"
5'-0"
2'-6"
A
15'-8"
3'-0"
5'-0"
5'-0"
5'-0"

SECTION B-B

Report of a Sanitary Survey made
of the Consumers' Ice Plant,
Leavenworth, Kansas,
with Suggestions for Improving the Quality
of Water used for Making Ice.

During the preliminary sanitary survey of the city made soon after Dr. Wilson of the U. S. Public Health Service was made City Health Officer, it was found that the water delivered to your ice cans was badly contaminated, although there was no apparent reason why the water should be impure as only condensed steam or distilled water was used for making ice. Inspection of the condensing, re-boiling, cooling and filtering systems showed that the only source of contamination was either by leakage from the flat cooler, contamination of the water by men working in or around it, or by dust or dirt getting into the storage tank or fore cooler.

Tests made at the outset showed that the cooling water in the flat cooler was not leaking into the distilled water and proved the trouble was beyond this point. Samples taken after the water passed through the filters were high in bacteria and those taken from the storage tank, fore cooler, and after passing through the small filter beyond the fore cooler, showed a high count.

It was evident from the results that the water as far back as the filters contained a large number of bacteria, but it was not evident just how the filters became contaminated and continued so after the long period of steaming to which they had been

subjected. The only explanation that can be given is that the layers of sand, charcoal and cotton waste which made up the filter medium became balled up in the filters, and when the steam was applied the center of the filter did not become heated sufficiently to kill all the bacteria and the few remaining rapidly developed when the warm water from the flat cooler was again applied. It is quite possible that enough bacteria remained in the pipes connecting the filters to keep them seeded after each steaming. It is quite natural that all the rest of the tanks and the small filter following the large filters should contain bacteria in as large or even larger numbers than were in the effluent from the charcoal filter and the small sand filter.

There ought not to be any difficulty in supplying water to the ice cans as free of bacteria as the water coming from the flat cooler. As your company was anxious to make any changes in the arrangement of the piping or the construction of the filters necessary to increase the purity of the water used in the ice cans, I agreed to make such suggestions as seemed pertinent from the analyses of the water at different points in the system beyond the flat cooler. These suggestions were as follows: first, to take the water from the flat cooler direct to the storage tank to permit the oil to rise to the surface and the iron rust to settle to the bottom; second, to clean out the sand and charcoal filters and fill them again with charcoal in the large filter and sand in the smaller one; third, the small filter between the fore cooler and the ice cans was to be opened and the cotton waste and sponges removed and the tank filled again with layers

of cotton waste, the different layers to be kept separate by wire screens; fourth, the storage tank was to be cleaned and sterilized and the fore cooler to be drained and an attempt made to sterilize it with steam; fifth, the fore cooler was to be kept covered at all times.

The suggestions contained in the preceding paragraph were carried out and the first set of samples analyzed were satisfactory, but a few days later, after it had been necessary for employees to work in the fore cooler, the bacterial count went up again; and as they continued to work more or less in the fore cooler during the remainder of the time the plant was operated the results were not as satisfactory as they ought to have been, or can be made when the plant is started in operation again. The last set of samples taken the day the plant was closed down and after the large filters had been steamed out were very satisfactory and no B. coli were present, and these results indicated very clearly that a pure water can be obtained when proper precautions are taken.

It may be argued that since there were no disastrous results from using the water as it was handled this last summer, there is no danger in continuing to use it in the same manner. This would be a serious mistake, for some time the source of contamination may be a man who has a mild case of typhoid fever, and in such a case the ice would scatter infection all over the city.

To guard against contamination of any kind the following recommendations are made for improving the quality of water to be used next year:

First. Pass steam through all the pipes between flat cooler and ice cans just previous to filling the ice cans.

Second. Scrub the storage tanks and fore cooler thoroughly and fill them with water to which one-half pound of bleaching powder (Chloride of Lime) has been added. Let them stand with this water in them for 24 hours.

Third. Thoroughly steam out all the filters and then let the water from the storage tank pass through the filters and waste away on the floor.

Fourth. Waste the water from the fore cooler.

Fifth. Wash out the storage tank and fore cooler with steam, wasting the condensed water.

Sixth. Place a drain line in the bottom of the storage tank.

Seventh. Place a cover over the storage tank and keep it there all the time.

Eighth. Keep a tight cover over the fore cooler and place a float in this tank to determine the height of water in it.

Ninth. Waste the first distilled water that passes through the tanks and filters until there is no odor of the bleaching powder.

Tenth. Steam and wash the filters only when the flow through them is so reduced that the level in the fore cooler is falling with all the valves on the filters open.

The ends of the pipes carrying the cooling water over the fore cooler should be cut off so that no water falls over the returns in the pipes carrying the distilled water. Here is where leaks are liable to occur and should leaks develop in the returns especially when untreated water comes from a creek flowing through the city such as is now used by your plant, very badly contaminated water is sure to be delivered to your ice cans.

If the precautions outlined above are observed next year when the plant is started in operation there can be no bad water go into the ice cans; but if the pipe lines, tanks and filters are not sterilized and the workmen are allowed to work in the tanks while in operation bad water is sure to result. No man should be allowed to put his hand in the water either in the storage tank or fore cooler and both should be kept tightly covered all the time.

The water used in making ice should be guarded as carefully from contamination as milk, and the precautions necessary for obtaining pure water can be so easily practiced that there is no excuse for not doing so.

I appreciate the amount of money your company has spent to obtain a pure water and I likewise realize your earnest desire to produce the very best ice that can be made, and I therefore

have every reason to believe that next summer the water you use for making ice will be of the very best quality.

Yours respectfully,

H. B. Hommon,
Sanitary Engineer.

Respectfully forwarded.

J. C. Wilson,
Assistant Surgeon.

THE CARE AND ATTENTION OF DISTILLED WATER Ice Plants required to prevent the Water from being contaminated in the Process of cooling and removing the Grease and Iron

by

Harry B. Hommon
Sanitary Engineer.
U. S. Public Health Service.

In one of the cities located near a large army camp the United States Public Health Service was called in to stop a typhoid fever epidemic and to establish sanitary regulations to prevent further outbreaks in the future. The army has authority over the sanitation of their camps but outside the camps in the districts known as Extra Cantonment areas the U. S. Public Health Service has jurisdiction. The sanitary conditions in the cities and town adjoining the army camps is second only to the sanitation of the camps themselves as the soldiers spend their time off duty in the territory adjoining the camps and much of the food for the soldiers is obtained from the adjacent cities and towns.

In making a sanitary survey of the city in question an ice plant that furnished more than 50 per cent of the ice used in the city was found to be using a water for making ice that was badly contaminated altho the company had a distilled water plant and was using every precaution they knew to produce pure ice. The conditions found here were perhaps similar to those at other plants where an honest effort is being made to obtain a pure product but through a lack of knowledge of the conditions which may contaminate the water, the company is unknowingly supplying an inferior quality of ice to the trade.

Briefly stated the course of the steam after leaving the engines was as follows; first, it passed through an oil filter and then to the cooler for heating the incoming water to the boiler. From there it went to the steam condenser, next to the tank where a part of the remaining oil was removed, on to the reboiler and after that into the flat cooler. Leaving here it passed through a set of filters, to be described later, and on to the storage tank from which it went to the fore cooler. From the fore cooler it passed through another small filter, which will likewise be described later, and then to the ice cans.

Between the flat cooler and the storage tank there was the first set of filters consisting of two units. The first, which received the water from the flat cooler, consisted of an iron tank 3 ft. in diameter and 5 feet deep. In this tank the filtering material as orginally placed consisted of alternate layers of sand and charcoal with wire screens between the layers to keep them separate. Cotton waste was placed over the bottom to keep the sand from washing out. There was an iron cover over the filter so that it could be operated under pressure. The second unit was 3 feet deep and 2 1/2 feet in diameter. It was built up as a filter by laying sand and charcoal separated by wire screens in the same manner as the first unit described above. This filter also had a tight cover and was operated under pressure.

In operation the water from the flat cooler passed through the first unit from the top through the filter to the bottom and then to the top of the second unit and through it and on into the storage tank from which it was drawn as needed to the fore

cooler. Just before going into the cans the water was passed through another small filter 12 inches in diameter and 18 inches deep made out of heavy boiler iron with a tight top. Inside the filter was placed originally a layer of cotton waste on the bottom, next a layer of sponges and alternate layers of each until the cylinder had in it all that could be forced down when the cover was place on it. The object of this filter was to remove the iron rust in the water that came from the fore cooler.

The large filters with the sand and charcoal were blown out with live steam for five hours once each week and the small filters with the cotton waste and sponges once each shift for 45 minutes.

When the survey was made typhoid fever was scattered all over town, and among the investigations made to locate some common carrier of the typhoid fever bacillus we came across the ice company referred to in a previous paragraph. The bacterial count in samples taken from the can filler ran as high as 5000 per cubic centimeter, and there were gas formers among them, which indicates contamination by fecal matter from man. The Ice Company impressed us as being very anxious to secure pure water and invited us to make a thorough search of their plant to locate the trouble.

Samples taken immediately after the water left the flat cooler showed that there was no coiling water leaking into the

distilled water but beyond that point all samples were badly contaminated, each one taken containing 5000 or more bacteria per c. c. and each one showing strong evidence of pollution from human sources. After looking over the situation and examining the filters thoroughly the following conclusions were drawn; first, the filtering material in the filters had so arranged itself that the steam applied passed up along the sides and did not sterilize the interior; second, through the carelessness of some workman about the plant the filters had became contaminated and the sterilizing was not complete when the steam was applied and the colon bacillus continued to thrive; third, the filter being contaminated, naturally the storage tank and fore cooler had impure water in them; fourth, the sponges in the small filter on the line between the fore cooler and can filler became cooked by the steam and were useless as a filter. The sponges and cotton waste was intended to remove the iron rust which causes red ice but were not accomplishing the purpose for which they were installed.

With the information in mind as outlined above the filters and piping were remodeled and changed as follows; first, instead of applying the water with its oil and iron rust from the flat cooler direct to the filter, it was piped to the storage tank where most of the oil rose to the top and a large part of the iron rust settled to the bottom; second, the large filter was cleaned out and filled with charcoal and nothing else except a screen over the bottom and one over the top; third, the smaller of these two filters was filled to a depth of 6 inches with clean pea gravel

resting on a fine mesh screen supported by a rack 8 inches above the bottom and over the gravel 24 inches of a good grade of clean sharp sand of medium size was placed. Fourth, the water, after passing through the charcoal filter and then through the sand filter, was discharged direct to the fore cooler; fifth, the small filter beyond the fore cooler in which the sponges and cotton waste was formerly placed was cleaned out and layers of cotton wastes 4 inches thick, separated by wire screens, was placed in it.

Rearranged, the water from the flat cooler first went to the storage tank to partially remove the oil and iron, then to the charcoal filter, next to the sand filter, on to the fore cooler, from there to the small filter filled with layers of cotton waste pressed down tight and separated by screens to keep it from balling up, and then to the ice cans.

The remodeled plant beyond the flat cooler has given excellent results. There is no more red in the ice, the water is practically free of bacteria, and where steam was applied to the two large filters for 5 hours once a week it is now applied to the sand filter for 30 minutes about once per week, and the small filter beyond the fore cooler is steamed out once each shift for 15 minutes where formerly 45 minutes was used and was not satisfactory. In "blowing" out the charcoal and sand filters with steam the object is to sterilize them and to remove the grease from the charcoal and the dirt, especially iron rust, from the surface of the sand filter. To do this most effectively valves should be placed on the outlet pipes from the filters where steam connections can be made without

letting out the water in the filters. The water supply to the filters being shut off the steam is turned on and waste-water valves located at the top of the filter medium opened. It is important that the waste-water valves at the top be located within a couple of inches of the top of the charcoal and sand, so that when the steam enters the filter is condenses and increases the volume of water, and the water already in the filter becomes treated and expands and thus provides sufficient overflow from the filter to carry away the grease that has collected in the charcoal filter and the sediment on the surface of the sand. The small filter located between the fore cooler and the ice cans should be blown out by passing the steam through the filter in the opposite direction to the flow of the distilled water through the filter.

The capacity of the plant outlined above is 50 tons and the filters described are one of two entirely independent sets. In new installations it would be advisable to provide an area of at least 12 sq. ft. for both the charcoal and sand filters and a depth 5 ft. and 30 inches respectively for a 25 ton capacity plant. For larger plants the area of the filters should be increased accordingly but for smaller plants the area should not be less than 10 sq-feet. As the functions of the charcoal and sand are different it seems advisable to include them in different filters in order to prevent them from mixing together and to get the maximum efficiency out of both. Wood or concrete are as satisfactory as iron tanks, in fact they have some advantages as they will not give off rust. For an ice plant of 25 tons capacity the filter used at the plant under discussion for removing the iron from the water just before entering

the ice cans was sufficient in area and depth, but a filter 18 inches in diameter and 12 inches deep would probably operate longer without cleaning.

Where distilled water is used for making ice there is great danger of the water becoming contaminated by carelessness of the workmen and much care and judgment must be exercised to see that the filters in particular, and also the storage tank and fore cooler, are constructed and arranged so that once contaminated they can be easily cleaned and sterilized.

The storage tanks for the water after it has passed through the flat cooler or filters should have a tight cover over them and the fore cooler should likewise be protected in the same way. Gauges should be placed in these tanks to indicate the height of water and under no consideration should workmen be permitted to put their hands in the water in these tanks unless they are thoroughly washed and rinsed. The warm water coming from the flat cooler is an excellent medium for the growth and development of bacteria and every precaution should be taken to keep them out.
The ice companies are selling the water coming from the flat cooler just as the milkman is selling his milk and both should use every precaution to see that their product is free of disease-producing bacteria. 73

The remodeled plant as described above is much cheaper to operate than the former arrangement, it can be operated with less attention, and a much better grade of ice is now being produced and it is pure. In justice to the ice plant referred to above it should be stated that the cause of the typhoid fever epidemic was not laid

to impure ice, but there always was the potential danger, and no ice company wished to operate their plant under such conditions.

Post Office Building,
Leavenworth, Kansas.
October 11, 1917.

Editor
Ice and Refrigeration,
Chicago, Illinois.

Dear Sir:

In the campaign the government is now conducting to bring about more healthful surroundings in the neighborhood of our army camps we can across conditions at ~~our~~ an ice plant here in Leavenworth, Kansas that I believe will be interesting to the readers of your journal. I have prepared a paper on the conditions found at this plant and I am enclosing it with this letter. You can use it in your journal if you think the manufacturers of distilled water ice will be interested in it.

In your issue of July 1917 I read a very interesting article entitled "Distilled Water Ice Problems" and it was this article that prompted me to prepare the one enclosed. As a sanitary engineer with years of experience in the study of filtration methods I feel quite at home in discussing the filtration part of the ice problem and my purpose in sending you this article is to help the producers of distilled water ice to understand the dangers of careless handling of their water and to make suggestions for efficient filtration to pure ice 75

We must look upon ice in the same way we do food products and any way you can give assistance towards helping producers to guard the purity of their product will be a step toward bringing

up the general health standards of the county at large. What experience I have had with ice manufacturers leads me to believe they very earnestly want to produce pure and wholesome ice but in many cases especially in the smaller cities and towns they have n never been properly informed on this important phase of their business.

Yours respectfully,

H. B. Hommon.

Sanitary Engineer.